Alberta Reliability Standard
Real Power Balancing Control Performance
BAL-001-AB-2

1. Purpose

The purpose of this **reliability standard** is to control **Interconnection** frequency within defined limits.

2. Applicability

This **reliability standard** applies to:

(a) the **ISO** except when:

(i) the **ISO** is receiving overlap regulation service;

(ii) the **ISO** is a member of a regulation reserve sharing group and remains in active status under the applicable agreement or the governing rules for the regulation reserve sharing group; or

(iii) the **interconnected electric system** is not synchronously connected to the **Interconnection**.

3. Requirements

R1 The **ISO** must operate such that the **control performance standard** 1, calculated in accordance with Appendix 1, is greater than or equal to 100% for each preceding 12 consecutive **month** period, evaluated monthly.

R2 The **ISO** must operate such that its clock-minute average of **reporting area control error** does not exceed the clock-minute **area control error** limit of the **balancing authority** for more than 30 consecutive clock-minutes, calculated in accordance with Appendix 2.

4. Measures

The following measures correspond to the requirements identified in section 3 of this **reliability standard**. For example, MR1 is the measure for requirement R1.

MR1 Evidence of operating such that the **control performance standard** 1 is greater than or equal to 100% as required in requirement R1 exists. Evidence may include dated calculation output from spreadsheets, system logs, or other equivalent evidence.

MR2 Evidence of operating such that the clock-minute average of **reporting area control error** does not exceed the clock-minute **area control error** limit of the **balancing authority** for more than 30 consecutive clock-minutes as required in requirement R2 exists. Evidence may include dated calculation output from spreadsheets, system logs, or other equivalent evidence.

5. Appendices

Appendix 1 - *Equations Supporting Requirement R1 and Measure M1*

Appendix 2 - *Equations Supporting Requirement R2 and Measure M2*

Revision History

Date	Description
2019-07-01	Initial release.

Appendix 1 – Equations Supporting Requirement R1 and Measure M1

The **control performance standard** 1 (CPS1) is calculated as follows:

$$\text{CPS1} = (2 - CF) \times 100\%$$

The frequency-related compliance factor (CF), is a ratio of the accumulating clock-minute compliance parameters for the most recent preceding 12 consecutive **months**, divided by the square of the target frequency bound:

$$CF = \frac{CF_{12-\text{month}}}{(\varepsilon 1_I)^2}$$

where $\varepsilon 1_I$ is the constant derived from a targeted frequency bound for the **western interconnection** or as revised by the **NERC**.

The rating index $\text{CF}_{12-\text{month}}$ is derived from the most recent preceding 12 consecutive **months** of data. The accumulating clock-minute compliance parameters are derived from the one-minute averages of **reporting area control error**, **frequency error**, and **frequency bias settings**. A clock-minute average is the average of the reporting **balancing authority**'s valid measured variable (i.e., for **reporting area control error** ($RACE$) and for **frequency error**) for each sampling cycle during a given clock-minute.

$$\left(\frac{RACE}{-10B}\right)_{\text{clock-minute}} = \frac{\left(\frac{\sum RACE_{\text{sampling cycles in clock-minute}}}{n_{\text{sampling cycles in clock-minute}}}\right)}{-10\text{B}}$$

And,

$$\Delta F_{\text{clock-minute}} = \frac{\sum \Delta F_{\text{sampling cycles in clock-minute}}}{n_{\text{sampling cycles in clock-minute}}}$$

The **balancing authority**'s clock-minute compliance factor ($CF_{\text{clock-minute}}$) calculation is:

$$CF_{\text{clock-minute}} = \left[\left(\frac{RACE}{-10B}\right)_{\text{clock-minute}} \times \Delta F_{\text{clock-minute}}\right]$$

Normally, 60 clock-minute averages of the **reporting area control error** and **frequency error** will be used to compute the hourly average compliance factor ($CF_{\text{clock-hour}}$).

$$CF_{\text{clock-hour}} = \frac{\sum CF_{\text{clock-minute}}}{n_{\text{clock-minute samples in hour}}}$$

The reporting **balancing authority** must be able to recalculate and store each of the respective clock-hour averages ($\mathbf{CF_{clock-hour\ average-month}}$) and the data samples for each 24-hour period (one for each clock-hour; i.e., hour ending (HE) 0100, HE 0200, ..., HE 2400). To calculate the monthly compliance factor ($\mathbf{CF_{month}}$):

$$\mathbf{CF_{clock-hour\ average-month}} = \frac{\sum_{\mathbf{days-in-month}}\left[(\mathbf{CF_{clock-hour}})(n_{\mathbf{one-minute\ samples\ in\ clock-hour}})\right]}{\sum_{\mathbf{days-in-month}}\left[n_{\mathbf{one-minute\ samples\ in\ clock-hour}}\right]}$$

$$CF_{month} = \frac{\sum_{\text{hours-in-day}}\left[(CF_{\text{clock-hour average-month}})(n_{\text{one-minute samples in clock-hour averages}})\right]}{\sum_{\text{hours-in day}}\left[n_{\text{one-minute samples in clock-hour averages}}\right]}$$

To calculate the 12-**month** compliance factor ($\mathbf{CF_{12-month}}$):

$$\mathbf{CF_{12-month}} = \frac{\sum_{i=1}^{12}\left[(CF_{\mathbf{month-i}})(n_{\mathbf{(one-minute\ samples\ in\ month)-i}})\right]}{\sum_{i=1}^{12}\left[n_{\mathbf{(one-minute\ samples\ in\ month)-i}}\right]}$$

To ensure that the average **reporting area control error** and **frequency error** calculated for any one-minute interval is representative of that time interval, it is necessary that at least 50% of both the **reporting area control error** and **frequency error** sample data during the one-minute interval is valid. If the recording of **reporting area control error** or **frequency error** is interrupted such that less than 50% of the one-minute sample period data is available or valid, then that one-minute interval is excluded from the CPS1 calculation.

A **balancing authority** providing overlap regulation service to another **balancing authority** calculates its CPS1 performance after combining its **reporting area control error** and **frequency bias settings** with the **reporting area control error** and **frequency bias settings** of the **balancing authority** receiving the regulation service.

Appendix 2 - Equations Supporting Requirement R2 and Measure M2

When actual frequency is equal to scheduled frequency, $BAAL_{High}$ and $BAAL_{Low}$ do not apply.

When actual frequency is less than scheduled frequency, $BAAL_{High}$ does not apply, and $BAAL_{Low}$ is calculated as:

$$BAAL_{Low} = \left(-10B_i \times (FTL_{Low} - F_S)\right) \times \frac{(FTL_{Low} - F_S)}{(F_A - F_S)}$$

When actual frequency is greater than scheduled frequency, $BAAL_{Low}$ does not apply and the $BAAL_{High}$ is calculated as:

$$BAAL_{High} = \left(-10B_i \times (FTL_{High} - F_S)\right) \times \frac{(FTL_{High} - F_S)}{(F_A - F_S)}$$

Where:

$BAAL_{Low}$ is the low **area control error** limit of the **balancing authority** (MW)

$BAAL_{High}$ is the high **area control error** limit of the **balancing authority** (MW)

10 is a constant to convert the **frequency bias setting** from MW/0.1 Hz to MW/Hz

B_i is the **frequency bias setting** for a **balancing authority** (expressed as MW/0.1 Hz)

F_A is the measured frequency in Hz.

F_S is the **scheduled frequency** in Hz.

FTL_{Low} is the low frequency trigger limit (calculated as $F_S - 3\varepsilon 1_1\ Hz$)

FTL_{High} is the high frequency trigger limit (calculated as $F_S + 3\varepsilon 1_1\ Hz$)

> Where $\varepsilon 1_1$ is the constant derived from a targeted frequency bound for the **western interconnection** or as revised by the **NERC**.

To ensure that the average actual frequency calculated for any one-minute interval is representative of that time interval, it is necessary that at least 50% of the actual frequency sample data during that one-minute interval is valid. If the recording of actual frequency is interrupted such that less than 50% of the one-minute sample period data is available or valid, then that one-minute interval is excluded from the **area control error** limit of the **balancing authority** calculation and the 30-minute clock would be reset to zero.

A **balancing authority** providing overlap regulation service to another **balancing authority** calculates its **area control error** limit of the **balancing authority** performance after combining its **frequency bias setting** with the **frequency bias setting** of the **balancing authority** receiving overlap regulation service.